zinc, and 1·6 per cent. zinc in lead. And the same may be said of the bismuth-zinc alloys when fused together in proportions greater than those in which these metals dissolve in one another.

IX. "On some Gold-Tin Alloys." By A. Matthiessen, F.R.S., and M. von Bose. Received August 28, 1861.

It was observed in a former research* that the gold-tin alloys had a great tendency to crystallize, and it was deduced from results then obtained that some of them were chemical combinations. With a view to ascertain whether these would crystallize out from the fused metals, the following experiments were undertaken.

The metals† were weighed out in the proper proportions, and fused together in a crucible over a 4-Bunsen burner, a jet of gas playing on the surface from above to prevent the oxidation of the tin. When fused, the lamp was removed and the alloy allowed to cool (the jet of gas still playing upon it) until the surface began to solidify, when the liquid alloy was poured off from the crystals. Of course the two metals were always stirred well, and cast several times before the alloy was crystallized and analysed.

When the metals were fused together in the proportion to form $AuSn_2$ (62·9 per cent. Au) and $AuSn_3$ (53·1 per cent. Au), no crystals could be obtained in either case. When, however, more tin was added, so as to make the alloy $AuSn_4$ (45·9 per cent. Au), a separation took place into a non-crystalline mass with a glassy fracture and a very crystalline one: these may be easily separated from each other by fusion, for the former has a much higher fusing-point than the latter. The alloy containing 43·5 per cent. gold behaved in the same manner. The analyses of the different parts of these alloys are given in the following Table. The gold was determined by dissolving the alloy in nitro-hydrochloric acid, and precipitating the gold from the strong hydrochloric acid solution with sulphite of soda:—

* Phil. Trans. 1860. p. 170.

† These were purified as described in the Phil. Trans. 1860, p. 177.

Composition of alloy.	Analysis of non-crystalline part in per cent. of gold.			Analysis of crystals.		
	1*	2*	3*	1st crop.	2nd crop.	3rd crop.
45·9 Au 54·1 Sn	47·7	48·3	49·0	43·3	43·3	42·5
				1st crop.	4th crop.	mother-liquor.
43·5 Au 56·5 Sn	47·0	.....	.....	43·3	43·1	41·5

The weight of the alloy employed for the first experiment was about 300 grms., of which the non-crystalline part weighed about 150 grms.: in the second experiment the weight of the alloy was about 250 grms., and the non-crystalline part weighed about 50 grms.

The addition of more tin did not cause any further separation into two masses. The following Table gives the results of the experiments made with the other alloys:—

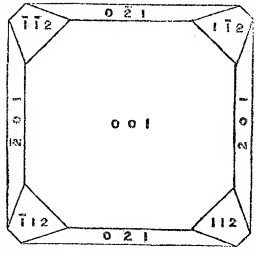
Composition of alloy.	Amount of gold per cent. in first crop of crystals.	Amount of gold per cent. in	Amount of gold per cent. in mother-liquor.
		2nd crop.	
41·8 Au 58·2 Sn	43·6	43·6	40·8
		6th crop.	
40·5 Au 59·5 Sn	42·9	38·7	
		4th crop.	
37·5 Au 62·5 Sn	39·7	37·6	32·9
		4th crop.	
65·0 Au 35·0 Sn	37·5	32·6	30·6
		4th crop.	
32·5 Au 67·5 Sn	36·8	35·2	28·7
		6th crop.	
30·0 Au 70·0 Sn	33·8	31·5	25·3
25·0 Au 75·0 Sn	27·4	.....	20·1

* This was re-fused in order to remove more completely the crystallizable part of the alloy; and as soon as a part had solidified, the rest was poured off. That which first solidified was analysed.

The weight of each of the alloys experimented with was generally about 260 grms., and that of each crystallization on the average 40 grms. In the last alloy, crystals fit for analysis could only be obtained in the first crystallization. The mother-liquor was, however, crystallized four times, and the last mother-liquor analysed.

We are indebted to the kindness of Professor Miller of Cambridge for the following determination of the crystalline form of the foregoing alloys :—

Description of the Crystals of Gold and Tin.



Pyramidal :

0 0 1, 1 0 1 = 50° 2′·7.

Observed forms :

0 0 1, 1 0 2, 1 0 4, 3 0 4, 2 0 1, 1 1 2, 1 1 4,

with very obscure traces of the forms

5 0 2, 4 0 1, 2 0 3.

The combination most frequently observed was

0 0 1, 2 0 1, 1 1 2.

The angles between normals to the faces, computed from a mean of the best observations, are—

0	0	1,	1	0	4 = 16° 37′
0	0	1,	1	0	2 = 30 50
0	0	1,	2	0	3 = 38 31
0	0	1,	3	0	4 = 41 50
0	0	1,	2	0	1 = 67 16
0	0	1,	5	0	2 = 71 28
0	0	1,	4	0	1 = 78 10
0	0	1,	1	1	4 = 22 53
0	0	1,	1	1	2 = 40 10
2	0	1,	0	2	1 = 81 25
1	1	2,	1	$\bar{1}$	2 = 54 16
2	0	1,	1	1	2 = 44 17

The faces of the form 0 0 1 are large and bright; those of all the other forms are extremely narrow, and are usually uneven.

Cleavage 0 0 1, very perfect.

No other forms of crystals than those just described were observed in any of the alloys experimented with.

The largest and best-defined crystals were obtained from the alloys containing about 41 per cent. of gold. The plates were sometimes, when crystallized from 300 grms., about 30 millims. long and 15 millims. wide, being the height and depth of the alloy in the crucible; they were generally of a bronze colour, proceeding from a slight oxidation of the tin: their true colour was that of tin. All the alloys emit a grating sound when cut through, as tin does, and are all exceedingly brittle.

From the above experiments it appears, first, that the well-defined crystals are not limited to one definite proportion of the constituents of the alloy, but are common to all gold-tin alloys containing from 43 to 27·4 per cent. gold; secondly, that crystals and mother-liquor are never of the same composition. These facts coincide with those found by Cooke* in his research on tin and antimony alloys, who observed that zinc and antimony are capable of uniting and producing definite crystalline forms in other proportions than those of their chemical equivalents.

X. "On the Sensory, Motory, and Vaso-Motory Symptoms resulting from the Refrigeration of the Ulnar Nerve." By Augustus Waller, M.D., F.R.S. Received September 3, 1861.

In a brief account of the effects of compression of the human vagus and sympathetic nerves†, I mentioned as one of the symptoms produced, "a tingling and heat of the ear corresponding to the side compressed, often lasting upwards of half an hour after removal of the pressure."

The sensations thus experienced are frequently of a hot, mordicant character, as if arising from the passage of a hot fluid through the vessels, extending progressively and causing a flush over the surface

* Silliman's American Journal, (2) vol. xx. p. 222.

† Proceedings of the Royal Society, No. 44, page 302.